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THE AMERICAN

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VOL. II. DETROIT, SEPTEMBER, 1885. NO. 5.

CURRENT NOTES.

THE INDIANA WEATHER SERVICE has recently lost by death two valued observers:—Mr. Luther C. Hager, at Terre Haute, and Prof. W. W. May, at Salem.

PROF. B. F. THOMAS of the University of Missouri, has been elected Professor of Physics in the Ohio State University, and will be president of the Ohio Meteorological bureau, succeeding Prof Mendenhall.

WINDS IN AGRICULTURE.—The part played by winds in fertilizing a district has been brought before the French academy of sciences by M. Alluard, in connection with the remarkable fertility of the Limagne valley in Auvergne. M. Alluard points out that the prevailing winds of the region are from the west and southwest, and traverse the mountain chain of the Domes, in which volcanic ashes are widely spread. The Limagne district lies east and northeast of the Domes, and is generally covered with a light mist, whereas the district west and southwest of the Domes has a clear and bright atmosphere. M. Alluard considers that the prevailing winds, which are sometimes severe, transport the volcanic dust over the country which they traverse, and it either settles on the ground or is brought down by rain or snow. Phosphoric acid has been discovered in the volcanic rocks of Auvergne, also potash and lime. The inexhaustible fertility of Limagne is on

M. Alluard's hypothesis, due to the renewed supply of these and other fertilizers in a state of extreme tenuity favorable for assimilation by plants. From observations made on dust brought down by rain on the summit of the Puy de Dome, M. Alluard estimates that twelve to fourteen ounces of dust descend on a square meter (10.75 square feet) in a year. The facts cited by M. Alluard are certainly interesting in connection with the role of the wind in strewing fertilizers on the soil.—*Chicago Times.*

DURING JULY the maximum temperature in New Orleans was 92 degrees, while in Boston it was 93 degrees, in New York 96 degrees, in Philadelphia 97 degrees and in Washington 99 degrees.

APROPOS OF THE FOLLOWING INCIDENT related by foreign correspondents, it may be mentioned that the sycamore is a very good natural lightning rod. A gentleman, who formerly resided in western New York, says that it was proverbially believed that a sycamore over a house or a barn would protect it, and the same statement has before been made to your correspondent.

In the city of Amiens the Hotel du Rhin has a natural lightning rod in the form of a sycamore tree. The tree stands in the garden of the hotel, and was struck for the third time on the 28th of May last. From the fact that the tree seems to discharge these heavy potentials without serious damage, it is inferred that its roots are in communication with a permanent body of water beneath the surface.—*Electrical Review.*

A table showing the increase of lightning strokes in the kingdom of Saxony, from 1859 to 1882 would seem to indicate that some steadily growing cause which should be sought out and remedied, is rendering thunder storms more frequent, or at least more dangerous than formerly.

The periods given in each case are three consecutive years. From 1850 to 1862, the number of strokes was an average of 67 per year. The average increase for the next period was 81, or 1.2 per cent. Following these by three year periods, the annual averages are 104, 123, 115, 189, or an increase of 1.6, 1.8, 2.2, 2.8.

These figures are from statistics collated by the statistical bureau of Dresden.—*Electrical Review.*

The difficulty of draining and cleaning the city of Mexico is well known. The following note on Lake Texcoco may be of interest in that connection:—

"Lake Texcoco is historical. It was in the way of Cortez and General Scott in their advances upon the city; Cortez passed around to the right and Scott to the left. One has not seen all until he has seen this lake, and it is a poor sight at best. It lies at the east end of the valley, and the general inclination is in that direction. Texcoco has no outlet, and it is really the cess pool of the city and valley. If there were ever fish in the lake they have been destroyed by the poison that has accumulated from the filth of the city. The water that is constantly poured into the lake through the canals has no means of escape except by evaporation. It is fast becoming a veritable Dead Sea. Some means must be devised to effectually drain the valley, if good health is to be maintained and the eastern portion extensively cultivated.

It has been stated that the lake is gradually filling with water; and that there is danger of its rising above its banks and overflowing the city. During the rainy season that end of the valley is considerably flooded, but the water rapidly recedes into the basin of the lake when the rain ceases. It does not seem that the city is in danger from that cause, but there is peril to the people from the effluvia that rises and infects the atmosphere."

Wave-Motions.—We clip the following from the May *Pilot-Chart.* The ships of the U. S. Navy have been engaged for sometime in making observations of the dimensions and speeds of deep-sea waves. These recorded observation are not so complete or numerous as is desired, and any assistance in this respect will do much to advance one important branch of the science of naval architecture.

The observations made where a ship falls in with a single series of approximately regular waves are most valuable, and should be accompanied by full records of the attendant circumstances.

One method of measuring the wave lengths consists of towing

a log line astern of a ship and noting the length of line when the chip floats on the wave crest next abaft that on which the stern of the ship momentarily floats. The ship should be head on, or allowance made for the departure of the log line from the head on position.

To measure the wave heights, when the ship is in the trough of the sea, and for an instant upright, the observer takes up a position such as the successive average wave ridges, as viewed by him from the trough, just reach the line of the horizon without obscuring it. The height of the eye above the water level correctly measures the height of the waves. To measure very high waves the observer may have to ascend the rigging, while for waves of less height a station on one of the decks may suffice, or some temporary expedient devised for placing the observer near the water level. It is desirable to select a position as nearly amidship as possible, but if it becomes necessary to take a station near the bow or stern, allowance must be made in estimating the height of the eye above water for the deeper immersion which may be caused at the instant by pitching.

The longest recorded wave measured a half a mile from crest to crest, with a period of 23 seconds. Waves have a length of 500 or 600 feet, and periods of 10 to 11 seconds, are the ordinary storm waves of the North Atlantic.

In regard to the heights of waves, the most trustworthy measurements show from 44 to 48 feet to be a remarkable height. Waves having a greater height than 30 feet are not commonly encountered.

This Office has blank forms for recording these observations, and would be glad to send then to any ship-master who would take sufficient interest in the subject to make observations whenever the opportunity arises.

EUROPEAN WEATHER.—*Review for June:—Barom. pressure.*—On the 1st and 2d there is a high pressure in the S. W. and a minimum in the N. E., on the 3d the maximum has traveled to Germany, while another disturbance appears in the N. W. where the barometer has fallen to 29.2 on the 5th the high pressure travels to the S. E. and the minimum is situated on the 7th over North Norway; another depression advances in the S. W., and on the 8th

has reached Holland, causing much precipitation; on the 9th it has reached Denmark, and on the 10th Finland, where the barometer has fallen to 29.1, with very much rain; on the following day it disappears in the N. E. ofter causing over North Scandinavia and Finland temperatures near the freezing point. A high pressure has now travelled from the west to Germany, and a new depression has travelled from Scotland to Norway. Over Central Europe the weather is warm and clear. On the 16th a low pressure is situated near Stockholm, causing severe storm on the Baltic coast. This minimum after causing precipitation over Sweden and the Baltic regions has dispersed on the 18th, while another is situated in the N. W. where the barometer again has fallen to 29.4. Under the influence of an area of low pressure over eastern Germany the temperature has fallen in Central Europe to 12° in 24 hours, with rain and thunder. On the 20th the minimum in the N. W. has increased in intensity and with a barometer stand of 29.1, is now situated near Sumburg Head on the Shetlands; strong to stormy winds, with rain are now general over Britian, Central Europe and Scandinavia. Travelling N. E. the low pressure disperses on the 22d in the North; another follows and has also disappeared on the 24th. A maximum has now formed over the N. E. parts of Germany with a stand of the barometer of 30.36. A slight depression is visible on the 25th, over Holland and another over Spain, while an area of high pressure advances from the British Isles. Under the influence of an area of low pressure in the S. E., rain and thunderstorms occur over Germany and France; this area spreads on the 28th to France and Spain, then over the whole of Southern Europe, its centre being situated on the 29th over the middle of France. Another slight depression coming from the Norwegian coast, has travelled on the 30th to Denmark, being enclosed by two maxima, one in the W. and another in the east, and causing very much precipitation (up to 3.62 inches in 24 hours) over Germany and France; midday temperature of 90° are now common in Central Europe.

Temperature: Germany.—It is below the normal from the 1–3, 10–13, 16–19, 21–24, and above the mean from the 4–9, 14, 15, 20, 25, 30; lowest on the 2d at Chemnitz, 50°; highest on the 9th at Breslau, 88°.

Ireland: Valentia.—The temperature is below the mean from the 2-6, 8, 9, 14-26, 29-30, and below the normal on the 1st, 7, 10-13, 27-28; lowest on the 3, 4, 8, 9, 23 and 26, 53°; highest 62°, on the 25th.

Russia: Petersburg.—The temperature is below the mean from 1-4, 8-19, 23-24 and 28; it is above the mean from the 5-7, 20-22, 25-27, 29-30; lowest on the 12th, 39°; highest on the 26th, 81°.

Sweden: Stockholm.—The temperature is below the mean on the 1st, 2, 3, 9-12, 14, 16, 27; it is below the normal from the 4-8, 13, 15, 17-26, 28-30; lowest on the 10th, 41°; highest on the 26th, 81°.

Dr. Less, at a meeting of the *Physical Society of Berlin*, spoke of two curves placed before the society, as markings of the barograph on April 22 and 23 during the time of the brief thunder storm in Berlin. The two curves presented in general an analogous course, concurring moreover with curves which Dr. Less had observed last year during the severe July storm. Before the outburst of the thunder storm the curves sank slowly, next rose steeply to a considerable height; with the attainment of the maximum of pressure coincided the stroke of lightning; the curve then maintained itself at a level for some time throughout which the thunder-shower or hail was wont to fall; on the cessation of rain the curve of atmospheric pressure sank steeply to beneath the former minimum. In the two April curves a further sudden rise preceded the second, weaker stroke of lightning, and then there followed several smaller jerkings of the curves coinciding with the time of the formation of clouds consequent on the short thunder-storm. In the curves of July of last year during the severe storm so copiously charged with lightning, the apex of the curves after the sudden ascent was not straight but consisted wholly of short indentations each of which appeared to correspond with an individual lightning stroke, so far as it was possible to fix the precise times. The sudden steep ascent of the curve on April 22 and 23 coincided with a sudden increase in the force of the wind, which soon, however, fell weaker, and at last sank to almost complete stillness.—*Nature.*

NOTES ON BAROMETERS.

The tension of the vapor of mercury is very important in the theory of errors of the mercurial barometer. The values usually employed are those of Regnault. Recent studies by Hagen and Hertz have shown that Regnault's values are far too high. At 32° the values of Regnault, Hagen and Hertz are, respectively, 0.020, 0.015 and 0.0002 mm., and at 212° 0.7455, 0.21 and 0·287.

Braun, of Berlin, obtains the atmospheric pressure by ascertaining how much more pressure is required to bring the mercury up to a fixed point—say 31 inches. The additional pressure is applied by water in a caoutchouc bag attached to the instrument, and the reduction is performed mechanically by the scale.

For filling barometers Dr. Waldo uses Wright's distillative apparatus.

Dr. Kayser recommends that in the place of a point from above for setting the level of the mercury in the cistern, a point from below be employed, as its contact with the surface can be more sharply and closely determined. He would also have a rod extending up through the mercury in the closed tube, the pointed tip of which, if the rod is of the same material as the scale, could be used as a point of reference and the error due to the expansion of the scale from heat, be thus eliminated.

In an excellent and compact form of the mercurial barometer, Fuess has introduced an arrangement by which the mercury can be driven into the closed chamber, and the amount of inclosed air thus determined. The open cistern is above the closed chamber and the distance between the levels in each is read from the same scale.

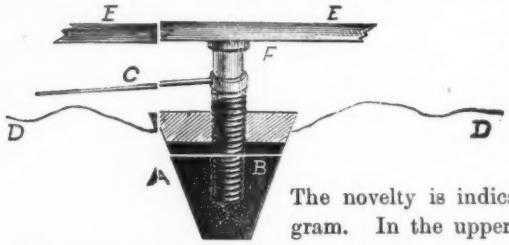
Probably the finest barometer in existence is that erected a few years ago by the Royal Prussian Commission of Weights and Measures at Berlin. It is a mercurial barometer, but with complicated apparatus, read with microscopes by artificial illumination. It is in general similar to the Russian normal barometer at St. Petersburg, but possesses some advantages over the latter. A description of the Berlin instrument may be found in the *Zeitschrift für Instrumentenkunde*, Vol. I, pp. 2–7, 1881; the Russian instrument is described in Wild's *Repertorium*, Vol. III, No. 1, 1874.

But neither of these was the first instrument of this class of barometers. The original is one which was put up in the Pulkowa Observatory about 40 years ago and was described in Struve's description of that institution (1845, p. 224), and redescribed in the first of the above mentioned periodicals, Vol. I, pp. 111–114. It was in regular use until 1876, when it was temporarily laid aside though yet serviceable.

As to the temperature errors of aneroid barometers, Hartl has found that for Naudet's instruments they do not usually change with the time, but do change with the change in air-pressure.

In order to obviate the temperature errors of the aneroid, Herbeck has devised the following ingenious construction which has been patented in Germany. A closed metallic box with a spring has attached to it a glass tube, the upper end of which is blown out into a flask. The box and part of the tube are filled with a liquid and the flask with air; and to the tube is attached a scale by means of which the stand of the surface of the liquid may be read. The air and liquid are in such ratio that for every change in temperature the liquid column remains unchanged, and to prevent more rapid changes in the air than in the liquid, the flask has a double wall inclosing more of the liquid. With this apparatus changes of level in the liquid in the tube are due only to changes of pressure on the box, and the device may be used for barometric or general manometric purposes.

I. D. Müller has patented in Europe,—but not, apparently, in this country,—a very simple arrangement for an aneroid which



has two or three advantages besides that of simplicity, the chief of which is inexpensiveness. The novelty is indicated in the diagram. In the upper plate, D D, of the vacuum-box is inserted a closed box A through the upper plate of which works the fine screw B. On a collar of this screw is carved the index G and, by means of a spring not represented here, the screw head always rests firmly on the glass cover E E.

Every change in position of D D causes a change in the position and consequently a rotation of the screw B and change in the direction of the index, and, if the thread of B is fine a slight motion in D D may cause a large rotation of the index. The device is so simple that the apparatus would not easily get out of order. The instrument can be made of small dimensions,—as small as a large coin. By actual trial it is found to be quite sensitive. This seems to be a good form for a simple and popular barometer.

The late Professor Klinkerfues' automatic weather predictor does not seem to be generally known in this country. To predict the weather, the rising or falling of the barometer is not enough the relative humidity must also be known. If this rises when the barometer falls wet weather is probable, and *vice versa*. Professor Klinkerfues set himself at work therefore to combine the barometer and hygrometer. On the middle points of one of the plates of the vacuum-box he fastened one end of a hygroscopic filament (hair, etc.) of which the other end was so fastened as to keep the filament taut. To this string was attached one arm of a lever, and the change from dry to threatening weather was indicated by the play of the other end. The apparatus was patented in Germany in 1880, and has since undergone some improvements and modifications.

When it is desirable for any reason to magnify the indications of change in air-pressure, the glycerine barometer is the best. The amount of change is 10 to 12 times that of the mercurial barometer and, if it is desired to attract the attention of the general public, the glycerine can be colored at pleasure. The length of the column is about 27 feet. The most of the tube may be made of gaspipe with a glass tube about 3 feet long at the top where the change in the level is to be made visible. The cistern may be filled with the glycerine and drawn through the tube with an air-pump. The free surface of the glycerine should be covered in order to prevent the absorption of water from the air, and the whole cistern may be tightly covered except a small orifice in which may be inserted a filter of cotton to keep out the dust of the air. Such a barometer was installed some years ago in the office of the London Times and is probably there yet.

It is very desirable to study the minute variations in the pressure of the atmosphere. The subject forms a study which is but fairly broached and which promises interesting results. At the last meeting of the American Association for the Advancement of Science Professor Trowbridge suggested the employment of a mirror on the most sensitive aneroid with the amplifying arrangements now familiar on many instruments as galvanometers, etc. At a previous meeting Mr. J. R. Paddock had described an arrangement of a similar character of which we give below the details as published in the reports of the A. A. A. S.: "The important feature of this barometer is the obtaining of a more accurate trace of the barometric variations, together with the ready indication of minute changes in this variation. The tube employed is the ordinary siphon tube with its extremities enlarged to one and one-tenth inches in diameter. A lever attachment is arranged as follows:

"A lever of the first order is constructed with arms one inch and eight inches long respectively; the shorter one has the form of a quadrant of a circle, and carries suspended by a platinum thread a glass jar of mercury, which is always perpendicular to the surface of the mercury in the tube.

"The whole system is delicately balanced at the fulcrum upon knife edges, riding upon plates of polished steel.

"The jar is filled so that the system just balances, when an additional drop of mercury is sufficient to cause it to rest upon the barometric column but in no way to visibly depress it. The longer arm of the lever carries a fluid pencil which leaves a permanent trace on paper, upon contact, little or no friction being required when once started.

"The mirror attachment consists of two small plain mirrors placed upon the axis of, and at right angles to, the lever. A ray of light being directed upon either of them, it is reflected back to a scale board placed at any convenient distance, and the variations of the mercury read off by means of a spot of light in a manner similar to that of a Thompson's Reflecting Galvanometer. A change of one-ten-thousandth of an inch in the column of mercury has been easily detected in this way, by an observer six feet from the scale board. The barometer has been in practical operation in New York city during the past winter (1880–81) and daily compared with the reports of the signal service officers, the results being invariably in close agreement when reduced."

TIDAL METEOROLOGY.

PLINY EARLE CHASE, LL. D.

In Chase's "Elements of Meteorology," (Part I, Chapter XVIII XX; Part II, pp. 105–10), some of the normal influences of tidal pressure upon atmospheric currents are explained, and illustrated by experimental tests, confirming principles which had been deduced from purely mathematical considerations.

The success of students of Haverford College, in forecasts which were based upon tidal influences, was so satisfactory that they calculated the weather probabilities, in all sections of the United States, for December 25, 1884, and January 1, 1885, which were submitted, through the courtesy of the Chief Signal Officer, to the "Board of Indications" of the Signal Service Bureau. The results of the test were published in the Journal of the Franklin Institute for April, 1885.

In the May number of the same Journal I gave a summary of the tidal influences which might be looked for during a period of thirty-two days, from May 15 to June 15, both inclusive.

The result of 2,838 reported observations at 90 different stations, during this period, show that 61 per cent. of the tidal forecasts were verified. Subjecting the local Signal Service predictions to the same limitations, of definite section and date, as were proposed and adopted for my own, they showed a verification of 70 per cent

The modification of the tidal forecasts by prevailing currents for one month in advance, showed a verification of 67 per cent. whereas only 53 per cent. of the Signal Service forecasts for two days in advance were confirmed.

The hygrometric tidal influences, near the Lakes, the Gulf of Mexico, and the Atlantic, showed a verification of 74 per cent.

All of the storms which occurred in fair tidal periods were anticyclonic in their origin.

While there is nothing in these results to warrant the attempts, which are frequently made at predicting severe and dangerous storms, the subsidiary value of tidal normals seems to be clearly demonstrated. That value is especially apparent in showing the irregular disturbances of atmospheric currents, in systematically co-ordinating continuous series of observations, in increasing the number of equilibrating influences which may be profitably studied, in detecting the approach of anticyclonic storms which would be otherwise unheralded, and in extending the period for which forecasts can be satisfactorily made.

METEOROLOGICAL AND SANITARY NOTES AT IQUITOS, PERU.*

The observations were taken at 9 A. M., 12 M., 3 P. M. and 9 P. M.

Measurements are on the French scale.

No observations of rainfall taken before June, from want of Gauge.

Months.	Year.	Average of Thermometer.	Average of Barometer.	Average of Wet Bulb.	Direction of Winds.	Direction of Storms	Number of Rainy Days.	Highest Day of Thermometer.	Lowest Day of Thermometer.	Highest Record of Thermometer.	Lowest Record of Thermometer.	Highest Record of Barometer.	Lowest Record of Barometer.	Highest Day of Barometer.	Lowest Day of Barometer.	Number of Inches of Rain.
March..	1871	25 9	75 37	24 3	N. E.	N. & E.	16	26 6	25 0	29 0	23 8	75 83	75 00	75 50	75 28	
April.....	"	26 2	75 43	24 5	N. E	N.	17	27 5	24 4	29 3	23 6	75 72	75 12	75 59	75 31	
May.....	"	26 1	75 49	24 4	S. E.	N. E.	13	27 9	24 2	30 2	22 7	75 86	75 17	75 74	75 33	
June.....	"	25 8	75 57	24 0	N. E.	N. E.	16	28 1	23 3	29 4	21 2	75 80	75 26	75 72	75 44	3 13
July.	"	24 9	75 62	23 0	S. E.	S. E.	11	28 1	19 4	29 5	18 8	75 99	75 32	75 94	75 43	4 27
Aug	"	26 1	75 53	23 6	N.	S. E	10	28 3	20 6	30 4	19 6	75 88	75 24	75 71	75 30	3 94
Sept.....	"	26 2	75 48	23 8	N. W	S. E.	8	29 6	22 2	32 4	21 4	75 84	75 08	75 71	75 29	9 33
Oct.....	"	2 . 9	75 38	24 6	N. W.	N. E	14	28 7	24 4	31 0	23 8	75 66	75 03	75 51	75 20	7 57
Nov	"	27 2	75 32	23 9	N. W.	S.E. / N.	16	29 0	25 8	31 8	23 9	75 62	74 96	75 45	75 06	8 39
Dec.	"	26 6	75 41	24 2	N. W.	NW / N E	13	29 1	24 5	31 4	23 4	75 77	75 18	75 65	75 26	11 45

From observation of the last 9 months at Iquitos on the Rio Maranon, the following are some of the general facts noted in 1871.

The cool winds are from S.E., and these are more frequent and fresher during the dry season from June to September. In June sometimes July and August, there are some three or four days of unusually cool weather,–when the thermometer is lower than at any other time of the year–called here the "Tiempo de San Juan" —known on the lower Amazon as "Tempo da friagem." The barometer always lowest with S.E. winds.

The warmest winds are from NW. and are more frequent in the wet season, from October to April. The barometer lower with these winds.

Fogs are infrequent—noticed in July and August more generally.

During the changing of seasons—about June—there is greater disposition to catarrhal affections among the people. During the changes about October, malarial disorders such as fevers and dysentary are more to be noticed. Intermittents to be noticed alone on the smaller streams and not on the main river,–reappear in those who have contracted them in their trading expeditions up the tributaries.

River commenees rising about middle of October, falls again

* Obtained by the kindness of Professor J. B. Steere, Ph. D.

the last of November for a few days, and then rises until about May.

About once every four or five years there is expected an unusual rise of the waters; such is the case this season (1871–72).

Climate of Maranon singularly free from dangerous diseases. Malarial disorders are tractable and are rare except on tributaries. Dysentery easily cured and not frequent; chiefly arises from the habits of the natives.

Skin diseases almost universal among the half-breeds and Indians.

Dirt eating a pernicious and almost incurable habit among children, and often among the grown—generally proves fatal by dysentery, anæmia, etc.

Most of these disorders are the result of personal imprudence and poor alimentation.

The average temperature for the night is not below 22 degrees, for the whole year; though during the cool spells of June and July it will go as low as 16° or 14°.

The number of "Rainy Days" in the table includes all those on which there was the slightest rain fall.

DR. FRANK L. GALT.

PNEUMONIA AND OZONE.

Since the beginning of this year there has been a severe and very fatal epidemic of pneumonia in this city, from which many of our most eminent citizens have died. Several of the leading physicians have stated that the deathrate from pneumonia this year has been much larger than that of the cholera in the year 1854.

As so much solicitude has been felt and expressed by the doctors and by the public at this sudden increase of death from pneumonia, I have thought that it was desirable to undertake a systematic study of the bearing of meteorology upon it, and see if there could be detected any connection between the weather and this disease in the city of New York. On comparing many thousands of observations from the self-recording barometer, thermometers (dry, wet, and sun), hygrometer, anemometers, and

pluviometer, with the mortuary statistics, there could not be found any continuous connection between these observations and the prevalence of pneumonia. But when ozone was taken into consideration, there was found to be a very close connection between its observations and the deathrate from this disease.

In the following table is given a summary of the deaths from pneumonia, the amount of ozone, and the number of days on which ozone occurred for the months of January, February, March, April and May for each year from 1878 to 1885 for the city of New York:

YEARS.	DEATHS.	OZONE.	NO. OF DAYS.
1878	1304	9.50	73
1879	1409	10.88	65
1880	1490	12.39	75
1881	1804	12.84	101
1882	2056	16.19	86
1883	2061	12.73	85
1884	1608	6.45	48
1885	2308	13.26	87

On an inspection of this table, it will be found that by the records of the Health Department of New York City there were for the first five months in the year 1878, 1304 deaths from pneumonia, while the observations at this observatory give 9.50 for ozone on 73 days for the same months. In 1882 the deathrate had increased to 2056 deaths, and the ozone to 16.19 on 86 days. In 1884 there was a decrease in the deathrate to 1608, and also in the ozone to 6.45 on 48 days. In 1885 the deathrate from pneumonia increased to 2308; the ozone had also increased to 13.26 on 87 days.

Having studied the observations thus far, the two following questions appeal to our attention.

(1) *What is ozone?* (2) *Can ozone produce pneumonia?*

For more than half a century scientists have been endeavoring to answer the first question. Some of them have called it "electricized oxygen," "allotropic oxygen," "active oxygen," "excited oxygen." Berzelius expressed the opinion that ozone was oxygen in a peculiar state. Becquerel demonstrated that oxygen may be converted into ozone by the prolonged action of electricity. By a majority of modern experimenters it has been admitted that

ozone is an allotropic condition of oxygen, similar to that which may be assumed by chlorine, as was shown by my father the late Prof. John William Draper, M. D., of the New York University, and an account of which was published by him in a memoir entitled, "*Allotropism of Chlorine, or its passive and active states,*" in the year 1845. Ozone like chlorine possesses powerful bleaching, disinfecting, and deodorizing qualities, and in a concentrated form both these gases are very destructive to animal life. According to Schönbein, oxygen is capable of assuming three different conditions, viz:—two contrary active states, and one passive. These have been named respectively ozone, antozone, and neutral oxygen. But why oxygen should assume its active or passive states little is known. My father found that the indigo rays of the solar spectrum could produce in chlorine the active condition. May not these same rays produce the corresponding state in oxygen?

In taking daily observations on ozone at this observatory, Schönbein's iodide of potassium and starch papers have been used, and also the iodide of calcium and starch papers. I have noticed that on some occasions, soon after the papers have been exposed to the atmosphere they change to a decided brown color, while after a few hours this brown color nearly disappears. On dipping the paper while still brown into water, the blue color of iodide of starch is given. This shows that antozone has been present in the atmosphere but has not had time to destroy entirely the ozone effects produced on the paper.

We come now to the consideration of the 2nd question, viz:

Can ozone produce pneumonia?

As to the causes of this disease, very little is known. Sometimes no cause at all can be traced. Very often it is supposed to be the consequence of exposure to cold, especially when the body has been previously heated by exercise. But why such exposure should in one person cause pneumonia, in a second, pleurisy, in a third pericarditis, and in a fourth, peritonitis we cannot tell.

If, as we have seen in considering the first question, oxygen has the power of assuming different forms, one of them preservative, another destructive, may it not in one or other of these forms produce inflammation of the substance of the lungs, etc., thereby causing their engorgement with blood not properly arterialized? I

think it might be well for physicians in their treatment of pneumonia, or its allied diseases to consider whether these diseases may not be due to ozone or antozone, and whether it may not be possible to neutralize the evil effects of one form of oxygen, by the use of the other. The further question arises whether the administration of pure oxygen to patients may not be the very worst treatment. It is well known that the oxygen of the atmosphere is mixed with about four-fifths of nitrogen.

I regret to see that so many meteorologists neglect the taking of ozone observations, because they are not satisfied with the results obtained. I think that the day is not far distant when we shall know the exact influence of ozone upon disease, and if it should be discovered that in other cities, there is the same connection between ozone and the deathrate from pneumonia, and its allied diseases, as there seems to have been in this city for the past eight years, shall we not have made the first necessary step towards mitigating the evil results of this disease upon human life, as well as its disastrous effect upon cattle under the form of pleuro-pneumonia.

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THE CLIMATOLOGY OF NORTHERN MICHIGAN AND ITS SUPPOSED RELATION TO DISEASES OF THE RESPIRATORY SYSTEM.

What are the influences, if any, which, in northern Michigan, are held to exert such a wholesome effect in this class of disorders ?

I submit this query to the readers of the *Journal*, hoping to elicit replies that will tend to determine, if possible, the preeminent factor or factors concerned in this result; whereas I shall endeavor to confine my remarks toward substantiating the fact or hypothesis of there being any such influence extant.

I am not aware of any freedom in this territory from the ordinary acute difficulties of the respiratory organs, as our inhabitants appear to suffer as frequently and severely from injudicious exposures, etc., as is found elsewhere. It is, however, in chronic bron-

chitis, chronic asthma, catarrhus æstivus (summer catarrh, or "hay fever" as commonly called), and other allied affections, that beneficial effects are here observed. I could almost confidently maintain that absolutely curative results are obtained, which would undoubtedly be true in many instances were the persons formerly afflicted, to remain continually in this section; but as is very often the case, upon returning again to the old haunts, a more or less rapid return of "the same old symptoms" is noticed. For instance, a friend formerly residing at Lansing, Mich.,—at which place his health was greatly reduced by chronic bronchitis, accompanied with some asthmatic peculiarities,—relates to me that upon changing his residence to the pineries of northern Michigan (Missauke Co.), he finds himself, without the aid of medicinal, or other extrinsical or intrinsical agents, to rapidly regain his former bodily vigor, and to be entirely relieved from the previously distressing bronchial symptoms. He experiences greater activity, increased appetite, a clearer perception, a greater bodily weight, deeper and easier respirations, and better sleep.

Another gentleman, a former member of the state legislature, informs me that although having been troubled with comparatively insignificant asthmatic symptoms for many years during his residence in Pentwater, Mich., yet coincident with his brief sojourn in Lansing, he experienced all the tortures of asthma, and vainly removed from one house to another, thinking that the immediate surroundings had some influence.

"At last," says this gentleman, "acting upon a sudden thought, I determined to test the effect of altitude upon my persistent enemy, and securing some bedding I mounted into the dome of the capitol building, and there at an elevation of about two hundred feet I enjoyed most delightful and refreshing sleep."

Certainly this is quite remarkable and admits of an explanation.

Still another friend advises me of his condition while residing in the western portion of New York. Five or six years since, he concluded to visit in the northern part of Michigan with a view to rebuilding his impared condition. His malady was of chronic asthmatic character and had defeated all previous attempts at mitigation. Shortly after arriving upon the lake shore in Oceana

Co., he experienced relief and very soon thereafter lost all evidences of his old associate. He has been, up to the present period entirely without distress or symptoms of asthma, or other bronchial difficulty.

More examples may be cited but they will not essentially differ from those quoted. There is a constant influx of wheezing and coughing individuals into the northern and western portions of this state and the universal verdict of all those interviewed appears to be that they have experienced and are experiencing, very decided relief.

A perusal of the reports of the State Board of Health, does not give any satisfactory knowledge bearing upon the prevelance of respiratory affections throughout the northern. north-western and western portions of the state, on account of the small number of correspondents in that section. Even were it possible to obtain full and complete reports of prevailing diseases throughout the region in question, they would be quite without value in a consideration of this character, as no distinction is entered between residents and non-residents.

Therefore while there might be a number of cases of bronchitis asthma, etc., reported, yet the major part of such cases would be among the non-resident portion of the population, properly speaking, who are attracted here to secure the beneficial results.

Mackinaw, Harbor Springs, Charlevoix, Traverse City, and Grand Haven are all more or less common as health resorts, and many thousand people are annually domiciled at these various points.

Now as regards the fact of the existence of some agent or influence, or a combination of agents or influences which produce this happy, health-giving effect, there can be no doubt. It follows that some cause or causes exist, and I would earnestly invite your readers to advance their opinions bearing upon this matter.

In regard to the *œtiology* of the asthma, I quote from a prominent medical writer, ... " a still more powerful cause is climatic influences the action of which on different patients cannot, unfortunately, be reduced within the limits of the law, but depends mainly upon the idiosyncrasy of the individual. Extremes of temperature, or excessive dryness or dampness, may

produce an asthmatic seizure, but in the largest number of cases one or two elements appear as the chief factor. One large class trace the attack to *dampness*, whether of soil or atmosphere, in combination with either heat or cold; another to *closeness* of atmosphere, and a want of proper circulation of air, such as is found in deep valleys and thick forests, and during thundery weather,—this last class experiencing great relief as soon as a breeze springs up. Malaria plays an important part usually in the causation of asthma." This author also remarks,—"Far more general and intelligible in its action is bronchial inflammation which is the cause in 80 per cent. of asthmatic cases." The intimate connection between ordinary bronchitis and typical asthma is thus portrayed. In fact, while bronchitis may exist without the slightest complication of asthma, asthma, on the other hand is invariably accompanied by bronchitis of moderate or severe intensity. Another author states, under the head of *Causes*,—"Change of locality has a remarkable influence upon asthma, but the conditions of climate which prove favorable are most diverse. Some do better in the heart of a great city, others on a dry and elevated plateau, others in a humid valley. Mental and moral influences are more potent than mere climatic peculiarities." *

In regard to this last statement it may be mentioned by way of explanation, that asthma is to a large extent a *neurosis*, and it is maintained that no definite or particular *pathological* change occurs. However that may be, it is invariably coexistent, at least with bronchitis of greater or less severity. The universally beneficial effects obtained here in conditions of varied peculiarity, also suggests an element other than idiosyncrasy.

The *ætiology* of bronchitis is well known. Pathologically, the mucous membrane of the bronchial tubes is changed in color from the usual pinkish, healthy hue, to a brownish or steel-grey. The follicles of the mucous membrane are hypertrophied. The connective tissue, especially the posterior part of the tubes, and the peribronchial connective tissue become greatly thickened; the cartilages are invaded and very much weakened. Under the

* May not this assertion prove to be the key to the entire mystery ?

strain of coughing the bronchi oftentimes yield and become dilated and the dilitations assume the cylindrical, fusiform and sacculated shapes. The secretions in chronic bronchitis differ greatly from the normal. Fragments of the detached epithelium, mucus and pus-corpuscles, are the morphotic elements. Some other minute pathological changes also take place.

Incidentally it may be mentioned that "Hay fever" is now conceded to be essentially a *neurosis*: that the same form of disease occurs in spring, summer and fall: that it is hereditary and a product of modern civilization: and that when the predisposition exists, various exciting causes may develop the disease, the most important of which is the pollen of plants, chiefly of the grasses. A number of cases have been advanced indicating that a mental impression may excite the disease.

The most peculiar of such cases, however, is one mentioned in Phœbus, wherein the symptoms of hay fever were excited in a very succeptible patient by viewing a highly realistic picture of a hay field. Pathologically it is not known to differ from simple catarrh of the mucous surfaces.

Now what are the climatic elements which conduce to alter these conditions? Does the atmospheric pressure exert any influence? Do the prevailing winds have any bearing? Is the relative or absolute humidity in any way involved? Will the temperature or range of temperature account in any manner? Is the condition of the soil at all conducive? Does the proximity of such large bodies of fresh water influence? Is the latitude, longitude or altitude at all concerned? Do the pine forests play any significant part? Or are the supposed meteorological influences but a vast hallucination, and that all the results observed are merely caused by a change in residence, and in the daily scenes, occupations and pleasures, unaccompanied by any other item?

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Pentwater, Mich.

THE ORIGIN OF THE ELECTRICITY OF THUNDER CLOUDS.*

Peltier supposed as a working hypothesis, to account for the electrical phenomena of the atmosphere, the earth to be charged with negative electricity. The best knowledge that we possess today, of these phenomena, tends to strengthen Peltier's hypothesis, and makes it no longer an assumption, but a reality.

For we know that in clear weather, the potential of the air increases with altitude, and any decrease in the distance of the insulated conductor, is attended with negative electricity. In fine weather, then, the earth may be said to be covered with a layer of negative electricity. The density of this charge is generally of very small value, and it is easy to see by calculation that the electrical attraction exerted is not sufficient to affect the smallest bodies; and its existence cannot therefore be directly demonstrated.

[*Note.*—The observations of Sir Wm. Thomson and Dr. Joule, at Aberdeen, have given 0.0045 electro static units as the potential variation for a centimetre variation in altitude.

Since $\frac{dV}{dn} = -4\pi\mu$ we get for the electrical density μ at the earth surface,

$$\mu = -\frac{1}{4\pi}\left(\frac{dV}{dn}\right) = -\frac{0.0045}{4\pi} = -0.00036$$

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* *Sur la cause de l'électrisation des nuages orageux.*

H. PELLAT, *Journal de Physique*, Januar, 1885.

Ueber die Ursache der elcctrische Ladung der Gewitter-wolken.

Zeitschrift der O. G. XX. Band, May, 1885.

The electrical pressure is given by the equation

$$\rho = 2\pi\mu^2 \text{ and } \therefore \rho = 2\pi \times (0.00036)^2 = .000,00082 \text{ dyne}$$

$\times$ centimetre squared.

This pressure is less than the weight of $\frac{1}{1000}$ of a milligramme.

It is true that the increase of potential for each centimetre of altitude being very variable, its value can in some cases be ten times greater than that obtained here. This would increase a hundred fold the value given for the electrical pressure. But even then its value would be too small to affect the lightest bodies.]

Under a cloudy sky the potential sometimes increases, sometimes decreases with increase in altitude, and the earth is sometimes negatively, sometimes positively electrified. The decreasing cases are infrequent, however, and the ground is generally negatively charged. Further, the value of a positive electrification under a clouded sky is always below that of the negative of the clear sky. We therefore agree with Thomson, in his conclusion, that if at any given time the surface of the globe is at some parts negatively electrified, at other parts positively electrified, the latter being of less value than the former, the surface of the earth as a whole may be considered as negatively electrified. It appears probable therefore that the air strata nearest the ground are negatively electrified, as the following conditions appear to require.

It happens frequently that a cloud is formed near the earth, and is in good conducting connection with it, so that, the original negative charge of the earth passes to the lower surface of the cloud. Now if the cloud rises and frees itself from the ground, and then dissolves away, its negative electricity is given to the air and electrifies it. Now if the air is charged with negative elec-

tricity, the value of $\frac{dV}{dn}$ increasing with altitude, the equipotential

surfaces are therefore so far from the earth, that their form will not be influenced by the condition of the earth's surface, or in other words, they will be horizontal planes, and the lines of force

in consequence, verticals. Then the sum of the three second derivatives of the potential (ΔV) reduces to $\frac{d^2V}{dn}$. Calling dn, the length of an infinitely small section of the vertical (reckoned upwards) we get from Poisson's theorem $\frac{d^2V}{dn^2} = -4\pi\rho$. Where the electrical density ρ is negative, then $\frac{d^2V}{dn^2}$ is positive. But this is the variation of the field $\frac{dV}{dn}$ with respect to altitude.

When the air is negatively electrified, the field has a value much greater in elevated regions than in regions near the earth. In those exceptional cases where the air is positively electrified, and the potential increases with altitude, the value of the field in high regions will be greater than in those near the earth.

It remains to prove now, 1st, that when the air is not electrified the charge on the earth is negative, however feeble it might be (see previous note) and is sufficient by induction to electrify storm clouds; 2nd, that when the air is negatively electrified its influence is added to that of the earth, to produce a still stronger electrification of the clouds.

We know that a conductor placed in an electrified field, as in an atmosphere where the potential increases with altitude, is strongly electrified by induction. Then if a certain region A of the conductor is in the neutral state and the potential of the surrounding air has the same value as the conductor, the part of the conductor which is above A will be electrified negatively and the part below A, be electrified positively. If the air were not electrified, the atmospheric field would have at all points (nearly) the same value as at the earth and the density μ, of this could be found by the formula $\frac{dV}{dn} = -4\pi\mu$.

Between the strength of the field, and the density at the earth surface, a certain relation exists, and we can consider the field as due to the presence of the layer of electricity at the earth surface and consider that it is this, which by induction, electrifies the conductor. The value of the field is determined experimentally.

It is very variable, but to fix our ideas, let us consider it as the increase in potential for a metre elevation, equal to an electro static unit of the C. G. S. system. A cloud is a sufficiently good conductor, to have little difference of potential at different points. If then, a cloud is formed in a sky originally clear, this cloud is strongly electrified, positively at the bottom, and negatively at the top. If winds shall separate the upper and lower parts, there are formed two clouds oppositely electrified. This explanation of the electrification of clouds by induction, is certainly not new, but we proceed to complete it by showing that the electrification so obtained is sufficient to give rise to our atmospheric electrical phenomena. To exemplify this, consider again the two clouds, whose formation has been described. Then, so long as they are in contact they will be nearly at the same potential. As they separate without change of altitude their potentials begin to differ. The upper cloud which is negatively electrified takes a potential lower than that of the other. And this difference can become considerable if the upper cloud falls, and the lower cloud rises. In short, the causes which vary the potential of the air strata and which, when the air is not electrified, keep it at the potential of the earth, will act with little change on clouds. Their operation will cause potential variations almost equal to the potential variations of the strata between which the movement occurs, i. e. the potential of the negative cloud diminishes while that of the positive increases, a unit per metre change in altitude. Supposing this change to be 500 metres for each cloud, there results a difference of 1000 electro-static units C. G. S. system.

Now the clouds in a storm may be displaced even a greater distance than 500 meters, while, on the other hand, the value of the field, which was taken, is often less than that near the earth; so that we are justified in saying: that when the air is negatively electrified, which it is likely to be, the strength of the field is much greater in elevated regions than near the earth.* So then, under the influence of the causes named, clouds driven by storm winds, and surrounded by insulating air, can acquire a difference of potential of many thousand electrostatic units. This hardly accounts, however, for sparks a kilometer or more in length. The experiments of Mascart on the difference of potential required to obtain a spark, between two balls,† throw light upon the matter.

We give in Fig. 1, the curve giving the results of his experiments. The differences of potential expressed in electrostatic units, are represented by the abscissas, and the lengths of the sparks corresponding, by the ordinates. The curve increases rapidly and is asymptotic up to the value of 500-600 units; or in other words, beyond this value the the electric spark tends to become infinitely great. It is evident, then, that the spark to be greater than a kilometre necessitates a potential difference greater than 500-600 units;‡ yet the above described operations can give a difference of many thousand units, and therefore could be considered sufficient to account for the great length of the spark.

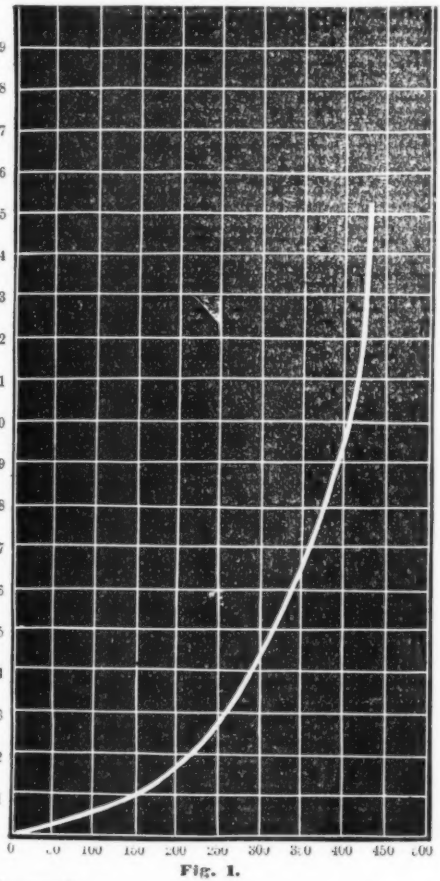

Fig. 1.

In the case of vivid lightning, it must be that there exists a very high electrification. But the charge depends not on the potential, but on the capacity, and it is evident that this can be very great. So then in order to account for the electrical phenomena of the atmosphere, it is not necessary to go further than to

assert the existence of a negative charge on the earth surface.§ Whence then comes this negative charge? We think it has always existed. Perhaps the earth, in its formation, received an excess of negative electricity, and being perfectly insulated in space has not been able to lose it. But should not this excess of negative electricity be dissipated in the atmosphere and disappear from the earth? This we have in part assumed to be the case, but most of it is returned to the earth again by rain. If a cloud forms in an atmosphere negatively charged the cloud receives the electricity, but when rain begins, the drops carry back the charge to the earth, and as gravity overcomes the electrical repulsion the effect is the same as if the earth had been permanently negatively electrified. We believe, then, that the electrical phenomena of the atmosphere can be explained simply by considering the earth as a globe negatively electrified.

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* We may remark that if contrary to what now appears probable, the air normally had an electric charge, and the value of the field decreased with altitude in some way not known, it would follow that the strength of the field would not be sufficient to produce the potential differences which the length of the spark demands. The truth of our hypothesis depends then on the truth of an assumption, which, while probable, is not certain: namely, that the air has either no electric charge or a charge that is negative. We think that experiments made with this end in view would soon prove or disprove the proposition; but we do not believe that those made up to the present time, decide the question. The method which to us seems best suited to clear up this point is to find out definitely whether the value of the field $\frac{dV}{dn}$ increases, decreases, or remains constant when the altitude increases.

† Mascart. Traité d' Électricité Statique, t. II. § 479, p. 87.

‡ The question hangs upon the point whether to have the discharge occur, requires a difference of potential much greater than that deduced by extrapolation on Mascart's results. The energy of the discharge is represented by ½ QV, V being the initial difference of potential between the two conductors, and Q the quantity of electricity. Then if a discharge occurs between two clouds, the potential difference being 500 or 600 units, we must give Q a greater value, and this necessitates giving the clouds a much greater capacity than they could have. We think that the lightning is produced by a potential difference greater than 600

units, but not much greater, than that which could easily be accounted for by the considerations already given.

§ Some writers have thought it necessary io admit the existence of a layer of positive electricity at the limits of our atmosphere, and to explain the electrical phenomena, and particularly the aurora borealis, on some such ground. Even admitting its existence, it is probable that the aurora is due to the silent discharges between the ice crystals in a cold highly electrified atmosphere. There is no occasion for supposing aught else than this which is almost certain; that there exists in elevated regions a potential much higher than that of the earth. These high regions may become negatively electrified by discharges from the earth surface. Were the atmospheric limit a conductor, the existence of positive electricity in the high regions would not be probable, but certain. Because, tubes of force from the earth would abut on that conducting surface, and since on conductors, the tube of force would enclose opposite electricities, and that on the earth surface being negative, the other would necessarily be positive. But there is nothing less like a conductor than the rarified air existing in high regions. It is probable that the tubes of force which leave the earth lose themselves in space, or impinge on extra terrestrial conductors which would become positively electrified. But the existence of a layer of positive electricity at the limits of the atmosphere does not appear probable, and has not yet in any way been proven.

A. M.

CAMBRIDGE, MASS., July 10, 1885.

SELECTED ARTICLES.

THE CONDENSATION THEORY OF THE GENERATION OF CYCLONES.*

Prof. J. Eliot, in a recent paper read before the Asiatic Society of Bengal, gave an account of the Southwest Monsoon Storms of June 26th to July 4th, and of November 10th to 15th, 1883. The first storm was generated during the last week of June, near the head of the Bay of Bengal, and gave very stormy weather off the Bengal and Orissa coasts, and was the only occasion on which it was necessary to hoist the storm signals at the Langor Island

*Quarterly Journal of the Royal Met. Society.

station, near the entrance to the Hooghly. The second storm was formed in the Gulf of Martaban, during the second week of November, almost at the end of the Southwest Monsoon, and pursued a very unusual course. It crossed into the Bay of Bengal through the channel between Cape Negrais and the Andaman Islands. It then slightly recurved, and moved in a general northward direction, approaching the Arracan coast near Akyab, where it was broken up by the action of the Arracan Hills.

Having given all the observations and discussed their more important features, Prof. Eliot proceeds to explain the chief features of these two storms as physical phenomena, and also to suggest the theory of cyclonic generation and motion which appears to be applicable to them, and is consistent with our knowledge of the physics of the atmosphere. He says:—

"In both examples, the greater portion of the mass of air that was thrown into a state of violent motion during the storm was for some days antecedent to the disturbances almost at rest, and in a state of approximate equilibrium. There was a break in the rains immediately preceding the formation of the first storm, which is well known to be a period of light and unsteady winds in Bengal, and over the head of the bay. The second storm occurred very shortly after the first break in the Northeast Monsoon rains on the Coromandel coast, and when, as the various observations prove, winds were light and variable over the greater portion of the bay. Hence the first and most striking feature of these cyclones was that a vast amount of kinetic energy or motion was rapidly given to a large mass of air, which previously to that action was in an almost quiescent state. The gradual increase of the motion was in those two examples proved from observations taken by vessels passing through the areas of disturbance. The transformation from the state of approximate quiescence to that of violent cyclonic motion in the bay is consequently a continuous process, the successive stages of which can be fully traced. And the entire development of these and of all storms in the Bay of Bengal, appears to be due to actions occurring over the bay itself, and not to atmospheric conditions at a considerable distance from the arc of cyclonic disturbance.

"The question of cyclone generation is therefore essentially one

of transfer of energy. Viewed in this light there are two subjects for inquiry:—1st. The source and character of the energy which is transferred to the atmosphere, and transformed into the kinetic energy of a mass of air. 2nd. The conditions necessary for the transfer of energy under consideration.

"If these two questions are fully answered, a satisfactory explanation will be given of cyclonic generation as a meteorological problem. The complete mathematical treatment of this subject as a dynamical question is beyond the scope of the present article.

"The energy which is transformed during the generation and existence of a cyclone, and which maintains the cyclonic circulation against the various resistances opposing it and therefore tending to disintegrate it, is undoubtedly the latent heat energy given out during the condensation of aqueous vapors contained in the atmosphere. In all cyclones of the Bay of Bengal that have hitherto been investigated, heavy, and in the majority of cases torrential, rain is the most prominent feature. It increases in amount during the generation of the cyclone, is excessive during the existence of the cyclone in its complete form, and rapidly decreases during the disintegration of the cyclone, ceasing with the disappearance of the cyclonic vortex. It is thus a phenomenon parallel in character and duration with the cyclonic motion or disturbance.

"It is also equally certain that when aqueous vapour is condensed into rain, practically the whole of the solar thermal energy utilized to perform the work of evaporation is given out by the mass of vapour during condensation, and is transferred to the adjacent mass of air. Major Cunningham's hydraulic experiments at Roorkee appear to establish that the sun's heat under the most favourable conditions, that is, with dry weather and high air temperature, does not evaporate more than one-tenth of an inch *per diem* from the surface of slowly moving water. The inverse process of condensation in consequence of certain features of air motion dependent on rainfall usually proceeds much more rapidly, and frequently restores the aqueous vapour in the form of rain to the earth's surface at the rate of one to two inches per hour. Prolonged rainfall at the rate of 10 to 30 inches *per diem* for periods varying from 24 to 72 hours is by no means uncommon during the passage

of the larger cyclones of the Bay of Bengal across the Bengal or Madras coasts. It is probable, judging from the expressions used by sailors to describe the rainfall during cyclones in the Bay, that it is more intense and prolonged than on land.

"If we therefore compare the rates at which evaporation and condensation can occur, it is certain that the energy released during the act of condensation is transferred to the atmosphere with very great rapidity during heavy rainfall, and probably at a rate occasionally amounting to 100, 200, or even 400 times that at which it was absorbed during the process of evaporation. The effect of a continuous fall of 20 or 30 inches of rain over any portion of the earth's surface would, on the assumption of Major Cunningham's results, be equivalent to that of a sun 250 times as powerful as our present luminary acting directly on the mass of the atmosphere above the area of rainfall, instead of indirectly by means of convection currents due to the heating of the earth's land surface. The action is also usually continuous, and is not interrupted, as in the case of the direct solar action, by the succession of night and day. There is, therefore, the strongest probability that so powerful a disturbing action can produce very large and rapidly accumulating effects on the mass of the earth's atmosphere affected and influenced by it in a comparatively short space of time.

"There hence appears to be no doubt that the energy transferred to the atmosphere during heavy rainfall is very large, and that the source of energy thus indicated is adequate, from every point of view, to account for the production of the largest and most intense cyclonic circulations. Other causes of the origin of cyclones have been assigned, as, for instance, differences of pressure, friction between parallel winds blowing from opposite directions, etc.; but the slightest consideration seems to show that none of these is sufficient to account for the enormous and continuous transfer of energy that occurs during the prolonged existence of a large cyclone. The strongest argument against these theories, in the case of cyclones of the Bay of Bengal, is, that experience has established that the larger the cyclone, the smaller are the antecedent differences of pressure, and the feebler are the winds blowing from opposite directions, immediately before the formation of the cyclonic vortex.

"The following statements, based on the preceding remarks, hence give the answer to the first part of the required explanation. When water is converted into aqueous vapor on the large scale at the earth's surface, thermal energy, derived from the sun, performs the work of evaporation, and is hence transformed. The aqueous vapor thus produced possesses an equivalent amount of energy, the greater part if not the whole of which it retains so long as it continues in the vaporous condition. When it is reconverted into water, or condensed as rain, this portion of its total energy is given out, and transferred to the air. The *modus operandi* of this transfer is a matter of no importance in the present inquiry. Also, in all cases when the rainfall is heavy, and prolonged for a considerable time, the energy is given out at a much more rapid rate than that at which it was absorbed during the process of evaporation. Hence heavy and prolonged rainfall may give rise to a powerful, persistent, and continuously accumulating disturbance in the adjacent atmosphere, and, therefore, produce violent and extensive air motion. In virtue of the constitution of the atmosphere, the motion will be rotatory. Prolonged heavy local rainfall is hence an adequate and sufficient cause. It is, moreover, the only known cause which is equal or similar in amount to the effect, and hence there are strong reasons for assuming that it is the motive power which produces the peculiar motion of the atmosphere called cyclonic circulation on the large scale. It is, in fact, the most powerful disturbing action to which the air is subject; and the consequent motion of the air is, when the rainfall and consequent disturbance are excessive, the most violent in its character with which we are acquainted.

"The history of the two cyclones has shown most fully that heavy rainfall over the area of cyclonic motion or disturbance was a characteristic feature, and that in this respect they confirm previous experience. Hence the source of the energy of these two cyclones was almost certainly that which we have indicated in the previous statement, that is, the latent heat energy of the aqueous vapor derived previously from the sun, and transferred to the atmosphere during the process of condensation.

"As rainfall does not always appear to produce cyclonic motion, it is clear that although rainfall may be the source of energy, it

is only when the rainfall occurs under special condition that the accompanying air motion increases and accumulates in the peculiar manner necessary to give rise to a large and intense cyclonic circulation. Experience has shown that the following conditions, which can be proved to have a direct bearing on the formation of cyclones, are always present before and during the generation of cyclones in the Bay of Bengal:—

"1st. The establishment and prevalence of a humid current over the extreme south of the Bay, which brings up large quantities of aqueous vapor into the centre or north of the Bay.

"2nd. The occurrence of approximate uniformity of meteorological conditions, more especially of pressure, over the coasts of the Bay, and frequently over a considerable portion of the Bay.

"3rd. The prevalence of light and variable winds over Bengal and the coasts southwards. This condition is practically identical with the previous, as both are due to, and accompany, the same general atmospheric conditions.

"4th. The absence of rainfall, and the prevalence of clear skies with fine weather, over the north and centre of the Bay, and in Bengal.

"The relative importance of these conditions will be evident on very brief consideration. The first is undoubtedly necessary to supply the aqueous vapour in sufficiently large amounts to give rise to a continuous heavy rainfall over such a large area as is covered by a considerable cyclonic disturbance. The Bay of Bengal is not large enough evaporating area to afford such supply. Hence cyclonic storms are only formed in the Bay of Bengal when there is a humid current blowing into it from the Indian Ocean. This occurs only during the South-west winds blowing at the entrance of the Bay or the northward continuatien beyond the Equator at the South-east Trade Winds of the Southern Tropics. That such is the case is sufficiently proved by the fact that cyclonic storms on the large scale are entirely restricted to that portion of the year when South-west Monsoon winds are blowing over a part or whole of the Bay, that is, from the beginning of May to the end of December. It is also shown by the fact that, at the commencement and termination of the South-west Monsoon period, any cyclones that are generated form in the south of the Bay, whilst

in the months of July and August, or during the height of the South-west Monsoon, they form near the head of the Bay. In short, the area of cyclonic generation in the Bay of Bengal depends mainly upon the season, and travels northwards or southwards, according as the South-west Monsoon is advancing or retreating over the Bay.

"The remaining conditions appear to be necessary in order that the rainfall may occur in such a manner as to give rise to and produce an atmospheric whirl. It is evident that if rainfall tends to set up a rotatory motion on the large scale that there should not be several separate centres of rainfall and disturbance, each producing its own rotatory or cyclonic action, and therefore interfering with the others. It is essential that the rainfall should be localized and concentrated, that it should continue for some time over a comparatively small area, and be confined to that area. The more perfectly that is realized, and the longer this continues, the greater will be the accumulated disturbance. In order that the rainfall may occur over the same area for such a considerable period as to permit of the continuous accumulation of action, it is evident that ascensional motion should mainly occur there, and therefore very slight differences of pressure at the sea level. The necessity for the further conditions is hence also evident.

"It will be seen that these conditions were fulfilled in the case of both storms, more completely (as might have been anticipated) in the case of the second storm, when the South-west Monsoon current was weaker than it was at the time of the first storm. The history and discussion thus fully bear out the existence of the conditions immediately antecedent to the two storms which the condensation theory asserts to be necessary for the initiation and generation of a cyclonic storm in the Bay.

"The preceding remarks hence indicate that the energy given out during the process of aqueous vapour condensation on the large scale is the motive power of cyclones, and that the rainfall must be localized and concentrated over a continuous and rapid accumulation of energy which characterizes a large cyclonic disturbance. Experience has also shown that the conditions which the condensation theory suggests as being essential for the occurrence of continuous and prolonged local rainfall over a por-

tion of the Bay are exactiy those which are present before and during all cyclonic storms in the Bay of Bengal, and that they are more fully marked before the occurrence of the larger than of the smaller cyclones of the Bay. It is, moreover, these antecedent conditions which form the only test or indication of the possible or probable early formation of cyclones in the Bay, and which are utilized in the preparation of the daily weather reports issued by the India and Bengal Meteorological Departments."

DEPOSITS OF VOLCANIC DUST IN THE GREAT BASIN.*

In contrast with the aridity of the Great Basin at the present time, geologists have shown that during the Quaternary it was crowded with lakes. In studying the sedimentary deposits of one of these fossil lakes, named Lahontan by Mr. King, I found strata of white, unconsolidated, dust-like material, which is undistinguishable in general appearance from pure diatomaceous earth. Beds of this material, varying in thickness from a fraction of an inch to four or five feet, were observed at a number of localities in the sides of the canons that have been carved in lacustrine strata of Lahontan age by the Humboldt, Truckee, Carson, and Walker rivers. Deposits identical with those of the Lahontan sections were observed at a number of localities among the mountains of Nevada and California at an elevation of several hundred feet above the former level of Lake Lahontan and at a distance of forty or fifty miles from its borders, thus showing that the deposits were both sub-ærial and sub-aqueous in their mode of accumulation. Further exploration revealed the fact that similar beds occur abundantly in Mono Lake Valley, where they may be seen to pass into well-characterized fragmental deposits of pumice and obsidian, thus suggesting that the finer material was also of volcanic origin. Experiment confirmed this hypothesis. Under the microscope the dust from a number of widely separated localities was found to consist almost wholly of angular flakes of transparent

* Abstract of a paper by Mr. I. C. Russell of the National Geological Survey; taken by permission from the Bulletin of the Washington Phil osophical Society.

glass, with scarcely a trace of crystallized matter. When a sample of pumice from near Mono Lake was reduced to a fine powder, it was found to present the same physical and optical properties as the dust in question, with which it also agreed closely in chemical composition, as shown by analyses made by Dr. Chatard, of the Geological Survey.

The Mono Craters, from which this dust is supposed to have been erupted, form a group of cones about fifteen miles in length, situated in the southeastern part of the Mono Lake Valley, California. These extinct volcanoes are composed almost entirely of pumice and obsidian, in the condition both of coulées, and lapilli, the latter constituting cones of great symmetry and beauty, the grandest of which have an elevation of nearly three thousand feet above Mono Lake. Some of these craters were in eruption during Quaternary times, while others were active after the ancient lakes and glaciers of the region had passed away. Many times during their history vast quantities of lapilli and dust were thrown out. As the volcanic dust interstratified with the sediments of Lake Lahontan is undistinguishable from that deposited in the Mono Basin, there is little room for doubting that they had a common origin. The greatest distance from the Mono Craters at which the dust was observed, was in the Humboldt Canon, about two hundred miles northward of the point of eruption.

At three localities in the Lahontan Basin the bones of extinct mammals were found closely associated with the deposits described above, thus furnishing the suggestion that the showers of fine volcanic dust were, at least to some extent, fatal to animal life.

LITERARY NOTES.

Das Wetter, Meteorologische Monatschrift für Gebildete aller Stände, herausgegeben von Dr. R. Assmann, Vorsteher der Wetterwarte zu Magdeburg, Vol. II. No. 6, June 1885.

(97) *Die Blitzschläge in den Fürstlichen Forsten im Jahre* 1884. The number of lightning strokes was 446, an unusually large number. Three quarters of them occured in May, June and July, and nearly two-thirds in the afternoon from 12 to 6. Over two-thirds of the thunderstorms

traveled between east and northeast. Of 81 trees struck, 40 were oaks, 23 spruce and 6 beeches. Many other statistical data are given.

(98) **Petermann,** *Die Kälterrückfälle im Mai.* A farther discussion of the ice-saints of May, showing that the popular conception of the days of cold is not entirely correct. A weather report for April in central Europe, crop reports, notes on Bishop's ring, on May thunderstorms, frosts and snows complete this number.

Ciel et Terre, Revue populaire d'Astronomie, de Meteorologie, et de Physique du globe, Bi-monthly, Vol VI, No. 8, June 15, 1885, Brussels, 8vo, pp., 169—192, 1 chart.

(99) **L. Mahillon,** *Le culte des phénomènes atmospheriques chez les peuples primitifs* d'aprês le comte Goblet d'Alviella. An interesting account of the religious associations by early and uncivilized peoples with the weather and other atmospheric phenomena.

(100) **F. Frenay** *L'agrandissement des astres à l'horizon.* According to the author, the apparent enlargement of celestial objects on the horizon is due only to the education of the sense of sight.

(101) **Les rivieres** *et les lacs de la Russie.* The rivers of Russia are subject to a regular annual flood, due to the melting of the northern snows. The Moscow pours out more water in the 25 days of the flood than during the remainder of the year. A layer of water of more than 40 inches is evaporated annually from the Caspian Sea.

A weather review and several notes complete the number. H.

Ciel et Terre. Revue Populaire d' Astronomie, de Meteorologie et de Physique du Globe. No. 9, July 1, 1885.

(102) C. **Montigney.** *La scintillation des étoiles dans ses rapports avec les phénomènes météorologiques.* In this paper the author gives a synopsis of the results of his own observations on the scintillations of the stars. The number of changes of color in the light of a star during one second of time, determined by means of an instrument called the "scintillomètre," which is used as a measure of the intensity of scintillation. The observations were made under the most varied atmospheric conditions; the temperature, humidity of the air, and the other meteorological elements were obtained from the nine P. M., observations of the Bruxelles Observatory Bulletin. From a discussion of the data derived from nearly seventeen hundred evening observations, extending over a period of fourteen years, the author arrives at the following conclusions: The intensity of scintillation is greatest in winter and least in summer; slightly greater in the autumn than in the spring. For two series of observations each containing the data obtained on 100 evenings, the mean intensity of scintillation for the series having 86 rainy days was 133, while for the series in which the number of rainy days was 45 the mean intensity was only 33. On the approach of rain a marked increase

in the intensity is observed, and a progressive diminution in the intensity takes place after the rain has ceased. During a squall the scintillations are very rapid; the author cites two cases, coming under his own observations, in which the intensity reached 211 and 333 respectively. During dry weather the greater the quantity of vapor in the atmosphere the greater will be the intensity of scintillation. Ordinarily, the intensity increases regularly with a decrease in the temperature. The quantity of water (whether in a gaseous, liquid, or solid state) in the atmosphere seems to be the principal factor which determines the character of the scintillation.

(103) **W. Prinz.** *Production de filaments du glace à la surface du sol.* The ice being in a plastic state is, on account of its increase in volume, forced through very small openings, giving rise to fantastic forms composed of numerous thread-like masses, each thread having the same cross-section as the opening through which the ice was forced. S.

Nature. A weekly illustrated journal of science, edited in London. McMillan & Co., 112 Fourth Ave., New York.

(104) **The Meteorology of Havana.** No. 16, p. 361. An editorial review. See this JOURNAL, pp. 28 and 382.

(105) **A Cloud-Glow Apparatus.** No. 19, p. 439. An instrument is described which was designed by Prof. J. Kiesling, of Hamburg, "for the purpose of exhibiting on an experimental scale some of the many-colored phenomena which are produced when direct sunlight, or electric light, penetrates a moist or dry cloud. In particular the apparatus can be used to produce on an artificially excited mist the same kinds of intense colorations which were visible in such extraordinary brilliancy in the winter of 1883–84 during the hours of twilight, at almost every place the world over."

The instrument consists of a large glass globe with attachments for filtering the air, etc. The air in the globe is allowed to expand and by this means a condensation of its vapor into mist is produced. When a ray of sunlight is thrown through this mist, colored phenomena are obtained resembling those produced by the passage of sunlight through clouds.

(106) **R. T. Omond.** On the Formation of Snow Crystals from Fog on Ben Nevis. No. 23, pp. 532–3. "There is on Ben Nevis a form of solid precipitation scarcely known on lower ground but of almost daily occurrence here. In ordinary weather the top of the hill is enveloped in drifting fog, and when the temperature of the air and ground is below freezing, this fog deposits small crystalline particles of ice one very surface that obstructs its passage. * * * * There is practically no limit to their growth; last winter during a long continuance of strong south-westerly wind and cold weather a post 4 inches square grew into a slab of snow some 5 feet broad and 1 foot thick in less than a week, the crys-

talline mass then fell off by its own weight and a new set began to form." The crystalline covering sometimes grows around objects at the rate of nearly two inches per hour and it is almost impossible to keep the meteorological instruments free from them.

(107) **The Work of the U. S. Signal Office Under Gen. Hazen;** from *Science*. No. 25, p. 580. The number of enlisted men and civilians employed in the Signal Service are first enumerated then are given the most prominent and important steps of progress taken during Gen. Hazen's administration; such as:—the introduction of consulting specialists; the higher education of some of the enlisted men; the organized study of tornadoes, thunder-storms, atmospheric electricity, thermometer exposure, barometric reductions, etc.; the stimulus given to the formation of State Weather Services; the introduction of a uniform standard of time, and a uniform standard of gravity for barometric reduction.

(108) **J A. Ewing.** A Recent Japanese Earthquake. No. 25, pp. 581-2. The writer gives a diagram made by a self recording instrument and a description.

(109) **Some of the Meteorological Results** of the Total Solar Eclipse of May 6, 1883. No. 26, p. 601. An editorial review. See this JOURNAL, p. 382. H. H. C.

(110) **Observaciones magneticas y meteorologicas** del Real Colegio de Belen de la Compagnia de Jesus **en la Habana.** January-June 1876. Havana, 1885, 4to with charts of the hourly changes of the elements for each month. Benito Vines, S. J., Director. This very useful publication is the most elegant in form and type of any that comes to our table. The director still continues his discussion of the relation of northers and magnetic variations. H.

(111) **Professional Papers of the U. S. Signal Service, No. XVI. Tornado Studies for 1884,** prepared under the direction of Major General W. B. Hazen, Chief Signal Officer, by Lieut. Jno. P. Finley, Washington, 1885, large 8 vo. 19 pages introduction, with three pages of observations and a set of four maps for the 18 principal tornadoes, also two general maps. This is a most valuable permanent record for easy reference of the important tornadoes of last year. The general maps give the general distribution of the tornadoes of last year, and the relative frequency in the different states. In the sets of four for each tornado are given the meteorological conditions for the three regular times of observation nearest to the time of the tornadoes, and a fourth chart showing the positions of the tornadoes and the path of the general cyclone. The table of observations contain brief descriptive notes. In the introduction is a list of all the tornadoes with their character, and the authorities from whom the information is derived. The total number is nearly 200, of which 38 occurred in January, and 45 in February. In 88 the direction of motion was NE., in only 23 to the south of east,

and in no case west. In 99 cases the cloud was described as funnel-shaped. In most cases the temperature was usually warm before, and cool after the tornado. The time of occurrence was usually from 2 to 8 P. M., 43 occurring from 4 to half-past 5. very few occurred after dark. Lieut. Finley thinks there are definite relations between the general storm area and the tornadoes. These are substantially those noted in these columns a year ago. This publication is a very welcome one to students of this subject and gives them on the part of the Signal Service, the information collected during the year. H.

(112) **Pilot Chart** of the N. Atlantic Ocean, July 1885. Issued by the Hydrographic Office, Bureau of Navigation, Washington. Floating ice extended during June below 40° latitude—to about 39½°. Numerous waterspouts were seen down the coast from Chesapeake Bay.

The collection of observations on the *use of oil at sea* are continued, and we have the following interesting notes published on that subject, which we take from the chart without change:

"For 48 hours we ran before the gale, and during the whole of the time we shipped very heavy seas, and the decks were continually full of water fore and aft.. We then had two oil bags made, filled them, and made one fast to the ring of each anchor over the bows. Within a few moments we saw the effects of it on the seas. In the wake of the ship they did not break, whereas outside of our wake the waves were breaking in all directions. Up to then we had run before the gale for 48 hours without heaving the log, none of the crew daring to go aft for fear of being washed overboard. After using the oil we did not ship any heavy seas whatever, and ever since we always use oil when running before a heavy sea. I would also recommend it to be used in ships that are lying-to in heavy seas. The bags were slung about two feet below the anchors, so that when the vessel pitched they were, at times, just awash. About one quart of colza oil was put in each bag every four hours."

Capt. George E. Lane writes from Annisquam, Mass., that his father, "during a voyage from Boston to St. Thomas, in an old fashioned high quarter-deck topsail schooner, called the May Flower, in September 1817, was caught in a hurricane when near Anegada, and dismasted. After the masts went over the side they were cut from the vessel to prevent doing damage. The wind was so severe that the boards and planks, the deck load, were blown from the deck like shingles in an ordinary gale. During all this time the schooner lay comparatively easy, so far as the sea was concerned, as he took the oil jug, (in those days they burned oil in the binnacle and candles in the cabin,) and inserted a quill through the cork, secured it bottom up, and let it drip out drop by drop, which had the desired effect in keeping the sea quite smooth about the vessel during the hurricane, which lasted several hours. The mainmast broke off above the sail, therefore, with the main boom and gaff a jury mast was

rigged, and in due time St. Thomas was reached in safety, with the cargo in the hold in good order. The vessel did not strain or leak during the gale, as she lay quite easy, not a sea boarding her during the time. Of course it was the oil that stilled the troubled waters."

"In 1845 I was in Rio de Janeiro when a shipwrecked crew reached that port. They had been wrecked on the reefs just north of cape Frio. The captain said the way he landed in the long boat was by using oil from the wreck to the shore, the oil causing a "slick" on the water, not a sea breaking until within a few yards from the shore, when one broke, capsizing the boat, but the whole crew reached the beach in safety."

"I followed the sea constantly over thirty-five years, from cabin boy to master. During that time had occasion to use it (oil) several times, always to great advantage. When making a passage in 1869 from Caldera to Hamburg, deeply laden with copper and silver ore, when passing cape Horn during a furious gale from the westward, scudding before it, the sea was so high and dangerous that I did not dare to bring the ship to the wind for fear of having the decks swept. One sea boarded us over the stern, doing considerable damage. I thought of what my father told me about the oil. We used it freely, and had no more trouble with seas breaking dangerously near. On the same passage had another gale, in about 40° south, when we used it for a few hours during a short sharp blow from W. SW., during which we lay-to."

The Hydrographic Office has been collecting data to determine under what circumstances the use of oil is most efficacious in diminishing the danger of breaking seas during gales of wind.

Masters of vessels are requested to make experiments in this matter whenever the opportunity occurs, and report the results to one of the Branch Hydrographic Offices, or directly to the central Office at Washington.

When sufficient data have been collected a pamphlet will be issued giving such directions in regard to the use of oil as the common experience of seamen may determine to be the best.

The following accounts have been received lately:

British S. S. Napier, Capt. Henderson, on January 26, 1885, bound from Baltimore to Cork, lat. 37° N., long. 50° W., encountered a hurricane blowing from NW., with a temendous sea from same direction. One sea larger than the others pooped the ship, carrying away companion etc., etc., and flooding the deck fore and aft. He at first intended to heave the ship to, but happening to think of the effect of oil, got two canvas bags and punched holes in them with a sail needle, then filled them with lamp oil, putting two gallons in each, which he found to last 2½ hours He made the ends of laniards fast abreast the fore rigging, allowing the bags to tow in the water. In this position he found they were swept on board by the sea, so he shifted the bags to about twelve

feet on either side of the stem, allowing them to hang down so as to be just awash. In this position they did admirably, the oil keeping the sea smooth to a width of about twenty feet on either side of the vessel until it reached the stern, when it spread out in the shape of a fan. He states that astern he saw the great seas approach the vessel to within sixty or seventy feet, when, meeting the oil, they would subside, and only a heavy swell would be felt on the vessel. He ran this way for three days and nights, and not a drop of water came aboard the ship. After the supply of lamp oil ran short raw paint oil was used with equally good effect.

When he left Baltimore he was in company with seven other steamers, two of which have not been heard from, and the others were three or more days behind him in arriving, they having hove-to while he, by the use of oil, was enabled to run his vessel in safety.

He also states that he thinks the oil saved his vessel from foundering, for in such a tremendous sea it is a question whether, in bringing her up to the sea, or after she was there, had he succeeded, she would not have been boarded by the seas and foundered.

Chief Officer Alfred Kuffle, of the English steamer Newcastle City, reports that when chief officer of the steamer Durham City, bound to Liverpool, in January, 1884, he encountered a furious gale from W NW, with tremendous seas. In running before it the seas threatened to poop the vessel. He took an empty paint can, filled it with neats-foot oil, punched a hole in the bottom, and one in top for a vent, attached a line to each handle and hung the can directly over the stern. The oil oozing from the hole in the bottom spread over the bottom of the can, and, as the sea struck the can, the oil being washed off, spread, and effectually prevented the from breaking.

Capt. E. E. Thomas, of the S. S. Chillingham, writes that during a voyage from Philadelphia to Queenstown in March, 1883, he encountered a heavy gale from SW.

The Hydrographic Office has established timeballs at Baltimore, New Orleans and San Francisco. The Naval Observatory has established them also on Man Island, near San Francisco, at Fortress Monroe and at Savannah, and is to establish one soon at Charleston.

(113) **Societa Meteorologica Italiana.** This society publishes a Monthly *Bollettino Decadico* which was noticed in the August number and of which we now have the numbers up to September 1884. It also publishes a *Bollettino mensuale*, of which our latest is for January 1885. This is a quarto of 16 pages. It is properly a Meteorological Journal containing articles of importance, correspondence, notices and reviews. As illustrations of the ground covered by this Journal we mention the following articles in the last number. Silvestri discusses a disastrous storm in Catania on October 7. De Giorgi gives an account of a whirlwind in

the Sahentine Peninsula on October 23. Several writers report on the November meteors. Professor Denza writes concerning the storm of December 20—21. Several pages are filled with accounts of earthquakes and twilight colors. The temperatures over North America are discussed and an abstract given of a lecture by Padre Cecchi in Turin. A review of the weather for the month and three reviews by Signor Roberti complete the number. The Bollettino Mensuale is most interesting and excellent.

(114) **Boletin del Ministerio de Fomento** de la Republica Mexicana, Folio, tri-weekly, Nos. 43—54, May 7 to June 10, 1885. These numbers contain the usual hourly observations at the city of Mexico with forest observations and summaries. A separate sheet compares the means by months from 1877 to 1884 inclusive and also gives the annual and general means for this period. These numbers also contain interesting discussions of the oleaginous and tinctorial plants of Mexico and of sugarcane and coffee. The discussions are of some length and are valuable. The observations are taken at the Central Meteorological Observatory, near the capital, and Senor Mariano Barcena is the director.

(115) **Elias Loomis,** *Contributions to Meteorology*; Read before the National Academy and reprinted from the Am. Journal of Science, July 1885, 8vo, 16 pp. 1 map. This is the twenty-first of Professor Loomis' papers. The direction of motion of areas of low pressure is first discussed. Above the latitude of 30° N, they travel easterly, below that latitude westerly. No definite areas of low pressure are found below latitude 6°, and between 6° and 30° there are two regions where they occur, in the Atlantic near the West Indies, and in the Indian and Pacific Oceans, near the East Indies and in the bay of Bengal. Their course is generally north of west. In general the motion of the storm area toward the east is due, not to the general drift of the atmosphere, but to the prevalent winds. The rate of progress is for thirteen years 28.4 miles. The velocity averages greatest in February, 34.2 miles, and least in August, 22.6 miles, but the velocity varies much in different years in the same month. The average velocity in the United States is about two-thirds greater than in Europe, and is more than a half greater than on the Atlantic. It is more than twice as great as that of the West Indian cyclones and between three and four times as great as those of the Bay of Bengal and the China seas. These remarkable results have been obtained from a large number of observations. There seems to be some relation between the mean velocity of the wind and that of storm-areas but on continents we must, apparently, take the wind at a considerable elevation.

(116) **Monthly Weather Review,** (General Weather Service of the United States), May, 1885. Prepared under the directien of Gen. W. B. Hazen, Chief Signal Officer, by Lieut. H. H. C. Dunwoody, Washington,

4to., pp. 113–140, 4 charts. There were seven areas of high barometer and seven of low, the latter having a mean hourly velocity of 24.4 miles. Ten Atlantic storms were registered. The following table of the most southerly extension of ice near Newfoundland is given for this month, and also the eastern limit:

Year.	Southern Limit.		Eastern Limit.	
	Lat. N.	Long.W	Lat. N.	Long.W
May, 1882	40° 46′	47° 35′	42° 40′	40° 00′
" 1883	40 30	47 00	45 40	45 12
" 1884	41 30	47 30	43 to	44 50
" 1885	40 50	48 15	42 30	40 10

The highest May temperature recorded was 110° at Yuma, Arizona; the highest ever recorded for the Signal Service in this month was 112° at Rio Grande, Texas, in 1879. The highest from any source for May was at Fort Ringgold in 1879, when the thermometer reached 123°. Numerous tornadoes were reported, as well as many floods, especially in Kansas and Texas. An excellent table of meteorological data is given on pp. 132 and 133. Earthquakes are reported from Winnemucca and Olympia, and from Austria, Turkey and Cashmere.

(117) **August Tischner** *The Fixed Idea of Astronomical Theory*, Leipzig, 1885, 8 vo. 86 pp. Herr Tischner deserves, certainly, the credit of persistence, even though his persistence is in an error, or rather a lack of comprehension. He has flooded the astronomical world for several years with his pamphlets in German and in English. His idea is that astronomers *must not* talk about relative motion. It is as if when one were riding on a railroad, one *must not* discuss his path along the car. It is perfectly proper to talk about either his course in the car, or the path of the car, or both, as suits his convenience. Just so we may discuss, with perfect propriety, the earth's course about the sun or with the sun. The author quotes disrespectful remarks from various eminent authorities concerning the Copernican theory. We must confess to a doubt as to their correctness; probably the inquirer misunderstood courtesy for agreement with himself. H.

(118) **Reports**—*Blue Hill Meteorological Observatory*, Blue Hill, Norfolk Co., Mass., elevation 635 feet., A. Lawrence Rotch, Proprietor, Willard P. Garrish, observer. Summary of observations for May. This observatory gives rain warnings. *Carson Observatory*, Carson City, Neb., elevation 4,630 feet. Chas. W. Friend, observer. June one sheet. *Illinois State Board of Agriculture*, Charles F. Mills secretary, Springfield, cir-

cular 123, June, with. Met. record of 38 stations. *Indiana Volunteer Weather Service*, Prof. W. H. Ragan, Director, Greencastle, one sheet of summaries from 39 stations for May. *Minnesota Weather Service*, Wm. W. Payne, Director, Sergt. D. R. McGinnis in charge. Eight octavo pages, 15 stations with summaries for June. *Missouri Weather Service* June 1885, A. Ramel, Assistant in charge, Washington University, St. Louis. Summaries from 38 stations for June, with map of rainfall. *McGill College Observatory*, Montreal, Canada, C. H. McLeod, Superintendent. Resumé of daily observations for June, one sheet. *Nashville Signal Service Station*, Sergt. L. N. Jesunofesky. Rainfall sheets issued weekly. *Ohio Meteorological Bureau*, May 1885, E. H. Mark, Secretary, Columbus. Pamphlet of 56 8vo pages. Resumès and summaries from 50 stations.

(119) **Rainfall Circular** by L. N. Jesunofsky, signal office, Nashville, Tenn. Mr. Jesunofsky's circulars show that the rainfall at Nashville during the first half of the year was about 25% below the average, the greatest being in February and March, when less than half the usual amount fell.

(120) **Monthly Report of New York Meteorological Observatory** Central Park, New York City. Daniel Draper, Ph. D., Director. The report gives in full the tri-daily observations of the barometer, wind, thermometers (dry and wet bulbs and black bulb in sun), hygrometer, clouds, rain and snow, and ozone; together with the daily and monthly means.

CORRESPONDENCE.

To the Editor:—It has seemed to me that the month of August of this year has been marked by an unusual number of destructive storms. I think it would be of interest to place upon record in the Journal—the destructive storms of each month. I give a list of those reported in the papers which I have noticed up to the 15th, and hope it may be completed by others:

Aug. 1 and 2—At Chicago, five inches of rain fell within twelve hours.

Aug. 1 and 2—At Toledo, a remarkable hail storm.

Aug. 1 and 2—Near Rome, Wis., crops destroyed by rain and wind.

Aug. 2—Storms of great violence swept over northern Spain, destroying lives and property.

Aug. 3—A terrific cyclone swept up the Delaware River, through the suburbs of Philadelphia, and across to Camden, N. J. The whole course of the storm was marked by death and destruction.

Aug. 3—A cyclone struck Smyrna, Del.

Aug. 3—A waterspout struck Lehigh County, Pa.

Aug. 3 and 4—Maryland was visited by floods, thunder storms, tornadoes and cyclones.

Aug. 6—A waterspout struck Lone Tree Creek, near Chadron, Dak., flooding the valley and drowning six persons and a number of horses.

Aug. 7—At Robinson, Ill., thousands of dollars worth of property destroyed by rain and wind.

Aug. 8—Racine, Wis, experienced the severest storm of the season.

Aug. 8—Lafayette, Ind., was flooded.

Aug. 8—A family of six killed by lightning at Iowa Rapids; violent thunder and lightning characterized this storm and but little rain fell.

Aug. 9—A hurricane in Liberty and Blanchard townships; great loss of crops and other property.

Aug. 11—Five inches of rain fell in less than twelve hours at Kansas City. Damage in the city and suburbs amounting to many thousand dollars.

Aug. 12—A terrific cyclone struck the village of Norwood, St. Lawrence County, N. Y. It swept away everything in its path. The fury of the storm was spent in three minutes; several killed and injured; more than a hundred buildings were wrecked. At the same time (5 P. M.) a cloud burst occurred at Hoffman's Ferry. Great loss on crops and other property; 500 feet of R. R., washed away.

Aug. 13—Very heavy rain storms in and around Saratoga, N. Y.; also in Wyandotte County, O., and at Wabash, Ind.

Aug. 13—This storm was very severe at Reading, Pa., and in that vicinity; also on Long Island and at North Concord, N. H., and throughout eastern N. Y. Z.

TO THE EDITOR:—In your issue of July I notice an inquiry entitled "Red Snow," by H. W. And in a foot note you ask the question if there was any deposit on the snow afterward.

I was an eye witness to that phenomenon and will try to give a statement of it as near as I can recollect it. It was in the winter of 1836, in the month of January; there was snow on the ground, and the night was clear (but no moonlight, as H. W. states it), that it occurred.

The phenomenon was very much like the one we had here on November 20, 1882, only more intense. The sky gradually became of a red hue, caused, I presume, by the same effect as the last one—that is a surcharge of electricity, and the simple reflection of it on the snow caused it to look red without having any other effect upon it whatever. The next morning the snow looked as white and clear as ever; and I think that if there had been snow on the ground in November, 1882, the same phenomenon would have been seen, only, perhaps, less intense.

I was then in the city of Newport, in Rhode Island. L. MARVILL.

PARKVILLE, MICHIGAN.

TO THE EDITOR:—Sunday evening, July 19th, at about 6:30 o'clock, an immense black cloud approached this station from the west, with great velocity. This cloud was preceded by a narrow and uniform white or light-gray band of mist extending across the heavens from north to south. This band in general appearance, size, conformation, and extent very much resembled the ordinary rainbow, though the color—as before stated—was whitish or light-gray. This band passed rapidly away and within a minute dense, compact, and very black clouds passed overhead at a high rate of speed. There was but very little wind, no thunder or lightning of any account, and but few drops of rain fell.

Reports from a point twelve miles east of here state that "when within about two miles the storm appeared to divide, the heaviest part going to the south."

This storm did not have the appearance of a tornado, as far as the writer was able to discern, and no damage is reported hereabouts, except the partial disabling of a vessel upon Lake Michigan, three miles north of this harbor. Many people were frightened.

G. H. CLEVELAND, M. D.

PENTWATER, MICHIGAN.

TO THE EDITOR. On the second day of the present month, August, there was a small whirlwind observed at Elmira, N. Y., which afforded a good illustration of the causes which produce such winds.

When first seen, the whirlwind was moving slowly along the middle of one of the streets, accompanied by a rapidly gyrating cloud of dust.

For some distance the street mentioned is bordered by Lombardy poplars which being slender in proportion to their height, their tops are good indicators of the direction of the wind.

During the afternoon the wind had blown in gusts and had shifted its direction to nearly every point of the compass.

Viewed from a distance the sight was a novel one to anyone interested. The tree tops on one side of the street were bent to the east while those on the other side were blown toward the west, thus showing the contrary currents, while in the middle of the street the whirlwind was slowly moving with the stronger current, as indicated by the tree tops, carrying the dust in spirals to a height of fifty or sixty feet.

At its base, the dust cloud was about twenty feet broad. When the tree tops indicated that the currents were even in strength, the cloud stood still. Resuming its course it proceeded as before, until upon reaching a sudden rise of ground it was dissipated. FRANK F. GRAY.

SEPTEMBER PREDICTION.—The average pressure of September will probably be considerably higher than that of August over the whole or nearly the whole of the United States, and the month will on the whole probably be a pleasant one.

In the eastern half of the United States the average pressure of the first part of the month, and especially of the first week, will probably be much lower than that of any similar interval during the month, and it is probable that during this interval the weather will pretty generally be cool and rainy.

Near the middle, or between the middle and latter part of the month, the average pressure will probably be quite high, and on some days higher than at any time since June.

Some of my data seem to indicate that the lowest pressure of the month will occur between the 2d and 5th, and if so will be accompanied by heavy rain in some sections, and by high winds followed by a day or two of quite cool weather.

HELM CLAYTON.

ANN ARBOR, MICH., August 24, 1885.

PREDICTION FOR SEPTEMBER.—The rainfall during August has exceeded the normal in the Lake Region, and has therefore exceeded my prediction in the August number of the Journal. The cold period during the latter part of the month has been prompt. Indeed, it seldom fails, so that such a prediction is safe to make. I find, also, that the large rainfall during August supports the theory of the slow eastward movement of weather areas, as there was somewhat excessive rainfall in Dakota and adjacent territories in July, while the weather in Michigan was quite dry. This fact was not known to me when the August predictions were written.

I judge from the Signal Service reports that there is still quite heavy rainfall west of the Mississippi River, which I think indicates a comparatively wet September in this section, and probably through to the Atlantic coast. So far as the meagre data furnished by the signal stations along the frontier of British America gives opportunity for judging, I think that the Arctic atmosphere has been driven well northward on this continent the present summer by the warm and moist winds from the Pacific

Ocean, and should September and October prove to be rainy months in the Lake Region and through to the Atlantic coast, I believe that a comparatively "open" winter may be expected, followed, probably, by an early spring break up.

It is interesting to note the fact that the great cold wave which entered on the Pacific coast of North America as far south as Oregon, early in the fall and winter of 1884, was felt with greatest severity in February and March in the Lake Region and moved across the Atlantic and chilled the atmosphere of central Europe in May and June. This cold wave was accompanied and followed by a period of comparative drouth, and during the summer months, when the North American Continent has had abundant rains, the drouth is reported to be still lingering in England and eastern Europe. I find also, by reports in eastern papers, that in eastern New York and perhaps adjacent sections, there was deficient rainfall, preceding the advance of the heavy rains which began in Michigan early in August. In all these facts there is to be found proof of the slow eastward advance of weather areas of all characters. These movements may not always be regular or easily traced in detail, but it is likely that they conform to a great general law that in time will come to be well understood and that at some limit perfect regularity and harmony exists.

L. A. SHERMAN.

THE GRIFFITH CLUB

MICROSCOPE

TESTIMONIALS.

The following are extracts from letters received within a few months

Roswell Park, M. D., Prof. in University of Buffalo:

The Club Microscope has safely arrived, and it is a beauty. If you ever want a written testimonial from me, it will give me pleasure to furnish it.

Prof. H. C. Griffis, Central High School, Binghampton, N. Y.:

We thoroughly believe the Griffith Club Microscope is the best.

F. L. James, M. D., Ph. D., Editor Microscopical Dep't "National Druggist," St. Louis, Mo.:

For general work, especially for students who have no fixed habitation, I think the Griffith Club perfection. The capabilities of the model are unlimited. It will do whatever any other instrument can do. Its fine adjustment is excellent and embraces features which are possessed by no other instrument, with which I am acquainted: as to finish it is superb.

Robert Aberdeen, M. D., Syracuse, N. Y.:

I received your Griffith Club Microscope day before yesterday—set it up and like it very much in every particular.

Rev. A. B. Harvey, The Author, Taunton, Mass:

It is, indeed, an admirable instrument; the best I know of, for what you clearly meant it. A *multum in parvo* both as a home and a traveler's stand.

J. T. Greenleaf, M. D., Owego. N. Y.:

The Griffith Club is a perfect stand. I don't want any better; can do any thing I want to with it.

Prof. Sarah F. Whiting, Wellesley College, Mass.:

The general plan of the stand, size, height, firmness, adjustment is perfect, and the compactness with which it can be packed, turn-table included, causes it to be without a rival.

Prof. Ada M. Kenyon, Buffalo Normal School:

My stand is like Wagner's music in that is bears the very closest acquaintance. It seems to me that for price and size there is nothing in the market that can approach it in beauty and adaptibility to work.

For circulars address,

E. H. GRIFFITH, Fairpoint, N. Y.

[From Issue of "Gems of the Northwest," by C., M. & St. P. Ry.]

The Only Pure Waukesha Water is the

WAUKESHA GLENN

THE WELL KNOWN "QUEEN OF WATERS."

Reigns alone among Natural Dietetic Table Water. Its numerous competitors appear to have, one after another, fallen away until it has no rival. The only spring in Waukesha that remains at one temperature, both summer and winter—i.e. 48°. The Waukesha Glenn Natural Mineral Water issues from a spring deeply imbedded in a rock, and is therefore of absolute organic purity.

What the Highest Authority in New York Says.

Certificate of Analysis.

Laboratory of the High School of Mines, {
Columbus College, New York, Nov. 10. {

SIR—The sample of Mineral Water from Wisconsin, marked "Glenn Mineral Spring," submitted to me for examination, contains in one U. S. gallon of 231 cubic inches:

Chloride of Sodium	1.1944 grs.
Sulphate of Potassa	0.4848 "
Sulphate of Soda	0.6212 "
Bicarbonate of Lime	15.9764 "
" of Magnesia	12.5795 "
" of Iron	0.0866 "
" of Soda	0.7594 "
Phosphate of Soda	0.0084 "
Alumina	0.0466 "
Silica	1.0497 "
Organic Matter	1.2160 "
	34.0230 grs.

This water appears to be identical with the Bethesda Water as it was before the the Glenn Spring was created by tapping the Bethesda stream.

Respectfully, your obedient servant,
C. F. CHANDLER, Ph. D.,
Professor of Analytical and Applied Chemistry.

The Waukesha Glenn Spring was created by opening a new outlet for the Bethesda stream, since which time it has caused the flow from the Bethesda Spring in dry weather to be almost exhausted, thereby rendering the Bethesda Water comparatively worthless, as shown from four analyses by Prof. C. F. Chandler, and other positive proofs.

The Glenn Mineral Water is the only diuretic water known in the world which acts directly upon the secretion of the liver, kidneys, urinary and generative organs, and is Nature's Sovereign Remedy for that numerous class of diseases that afflict the human family—and as medical statistics show us, comprises over one-half of those which terminate life.

This water will keep fresh and sweet, tasting neither stale nor flat, and is the only Mineral Water from Waukesha that will keep, which is positive evidence of its superior medicinal properties.

Waukesha Glenn Mineral Spring vs. Bethesda.

Have the curative properties of the Bethesda Spring Water depreciated, and are their original virtues found to exist to-day in the waters of the GLENN SPRING? This is the great paramount question overshadowing all others; and its solution is not to be determined by what R. Dunbar or I may say. It is not with me that these parties have their quarrel, but with science, which, through the highest chemical authority on this continent, Prof. C. F. Chandler, of the School of Mines, Columbia College, New York, declares that while the mineral solids in the Bethesda Water have fallen of fully 50 per cent. from what they were originally the organic matter has increased fully 100 per cent., and further, that the exact properties which once gave these waters their wonderful curative powers, are now found in the waters of the Glenn Spring.

Read the evidence as presented in the several analyses made of these respective waters. The original analysis of the Bethasda Water, as shown in Col. Dunbar's circular, gives:

Total Salts	35.710 grs.
Total Organic & Volatile Matter,	1.983 "
Leaving as Solid Matter	33.727 grs.

These were the constituent elements of this far-famed water that carried life, vigor and health to all that drank at this healing fountain. Have they been preserved and maintained? Let us see. The two following recent analyses of water from this same Bethesda Spring, and by this same distinguished scientist, called forth the following certificates:

Certificate of Analysis.

New York, Sept. 14.

SIR—The sample of water marked "Bethesda" (Dunbar's Spring), submitted to me for examination, contains in one U. S. gallon of 231 cubic inches:

Total Solids	21.286 grs.
Organic and Volatile Matter	3.848 "
Solid Minerals	17.438 grs.

Respectfully, your obedient servant,
C. F. CHANDLER, Ph. D.,
Professor of Analytical and Applied Chemistry. To J. K. Glenn, Esq., N. Y.

DEAR SIR—The sample of Spring Water from Caswell, Hazard & Co., marked "Bethesda Water" (Dunbar's Spring), submitted to me for examination, contains in one U. S. gallon of 231 cubic inches:

Total Solids	21.846 grs.
Organic and Volatile Matter	4.082 "
Mineral Salts	17.764 grs.

Respectfully, your obedient servant,
C. F. CHANDLER,
Professor of Analytical and Applied Chemistry. To J. K. Glenn, Esq., N. Y.

WAUKESHA GLENN.

TESTIMONIALS.

For about two years I have been troubled with my liver, resulting in loss of flesh from my usual weight of 180 pounds down to 120, with a sure prospect of final end in a very few months—so all the doctors said. Finally I concluded to try Glenn Spring Water, that you shipped to me from the springs. For two months the effect was more than astonishing, from death (sure) to life. It was wonderful. June 1st I was able to take the road again, and have not lost a day since, getting better every month, gaining from 120 to 165 pounds. Those who saw me last winter did not expect me to live till July, and will now testify that all I say, and even more, would be true. May the Glenn Spring continue to run pure water for ever and ever. D. W. C. HOUSE,
Kansas City, Mo., Moline Plow Co.

PHILADELPHIA, August 6.

DEAR SIR—It is with great pleasure that I have to inform you of the wonderful effect the water of your springs has had upon my wife, who was unable to leave her room with chronic Bright's disease. It seemed to affect every part of her body with pain, and sleepless nights, so that the doctor gave no hopes of her; but since drinking of the Glenn Mineral Water she has not only been able to leave her bed and room, but to take long walks of one and two miles, and is fast improving in health and strength. We have now done away with all other remedies, only using the water, which keeps perfectly sweet in the manner you put it up. You will please send me at once another barrel.
Yours respectfully, JOHN RESTEIN.

48 HATHAWAY ST., CINCINNATI, April 22.

DEAR SIR—Enclosed you will find check for which you will please send me two barrels Glenn Water. I have several customers who have received substantial benefit from the use of the water, and as for myself, I think I am entirely cured of my kidney trouble, after five years' affliction. The water I bought of you last summer is just as clear and sweet now as water that I drank from your spring when I was there, while all the Bethesda Water in this market is off in color and stringy in substance.
Yours truly, THOMAS VAN NAME.

OVID, MICH., July 5.

DEAR SIR—The half barrel of mineral water I ordered for Mr. Shattwack has helped him amazingly. For several months he has had to use a catheter, but that necessity was entirely removed after using the water a few days. As regards my own case, I would say that I am about cured of Bright's disease. You will please ship me another barrel; it is for Mrs. J. Skerritt, of Victor.
Yours truly, W. HATHAWAY.

CLEVELAND, O., July 5.

DEAR SIR—Please send me one barrel of the Glenn Mineral Water to each of the following addresses. My friend, Mr. Sellers, has found so much benefit from the water I ordered for him that he tells me that he has ordered another barrel, and has just received it, and I am happy. I feel tip-top and I am a living advertisement of your excellent water. Yours truly, W. WILSON.

AMES, N. Y., August 24.

DEAR SIR—Send me another barrel of water. It is for a neighbor, Mr. B. Mount. I let him have ten gallons from my barrel, and it has helped him more than two years of treatment from the most skilled doctors of the Mohawk Valley.
Very truly, SAMUEL STEVENS.

Please send me as before one barrel Waukesha Glenn Water. The Waukesha Glenn Water is the best in the world, and my physician says, the greatest. It is deserving of all praise. GEORGE H. PEABODY,
118 East Elizabeth St., New York.

BOSTON, MASS., July 12.

DEAR SIR—Please send me five barrels of Glenn Water. Pleople here are learning the merits of Glenn Water.
Yours truly, JOHN SULLIVAN.

These, with the thousands of actual cures and benefits, ought to convince the most skeptical. The medical profession, without exception, indorse and prescribe it with the CAUTION TO AVOID the more harsh spring water, also those containng SALT in imitation of foreign waters.

THE WAUKESHA GLENN is the only specitic known for the hitherto incurable diseases—Diabetes, Bright's Disease and all Kidney Affections. It has been tested by thousands whose unsolicited testimonials are open to the public, and furnished to all who desire, MAILED FREE.

Address, **T. H. BRYANT, Waukesha, Wis.**

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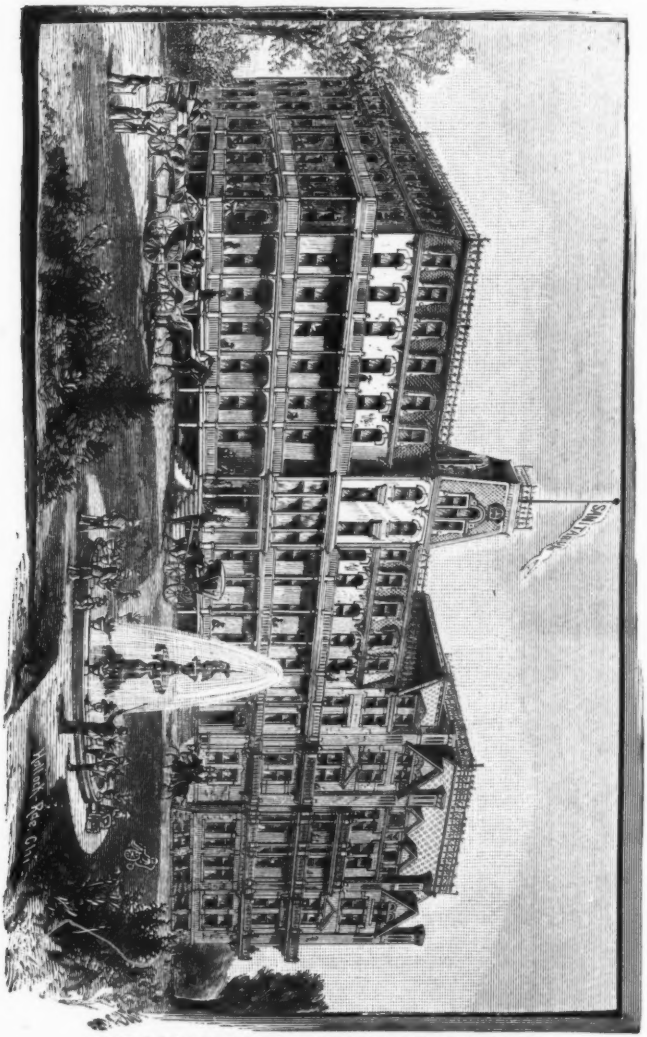

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